Analyzing the Evolution and Distribution of Nuclear Weapons Across the World

Jay Pratap Singh Bhadoria

2024-12-18

1. Introduction

This report analyzes global trends in nuclear warhead stockpiles using publicly available data. The key insights include:

- Global Trends: Total warhead counts over time.
- Key Nuclear Powers: Comparative analysis of top nuclear-capable nations.
- Geographical Distribution: Regional insights into stockpiles.
- Trends Over Time: Highlight reductions or escalations.
- Policy Insights: Strategic implications for defense planning.

---

2. Data Preparation

```
knitr::opts_chunk$set(fig.width = 6, fig.height = 3, fig.align = 'center')
library(rnaturalearth)
library(rnaturalearthdata)
library(sf)
library(tidyverse)
library(ggplot2)
library(dplyr)
library(readr)
library(ggthemes)
library(gridExtra)
library(patchwork)
library(viridis)
library(knitr)
library(viridis)

url <- "https://ourworldindata.org/grapher/nuclear-warhead-stockpiles-lines.csv?v=1&csvType=full&useColu
nuclear_data <- read_csv(url)

nuclear_cleaned <- nuclear_data %>%
  rename(
    Country = Entity,
```

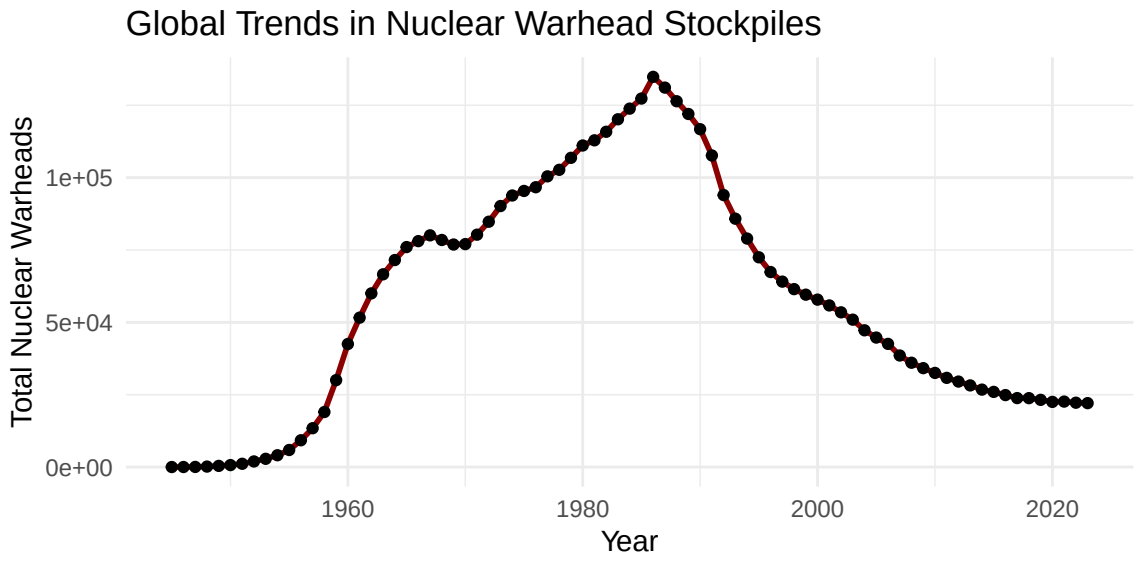
```
    Year = Year,
    Warheads = `Number of nuclear warheads`
  ) %>%
  filter(!is.na(Warheads))

glimpse(nuclear_cleaned)
```

```
## Rows: 869
## Columns: 4
## $ Country  <chr> "China", "China", "China", "China", "China", "China", "China"~
## $ Code     <chr> "CHN", "CHN", "CHN", "CHN", "CHN", "CHN", "CHN", "CHN", "CHN"~
## $ Year     <dbl> 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1~
## $ Warheads <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 5~
```

3. Global Trends

The following plot shows the total global nuclear warhead stockpiles over time.

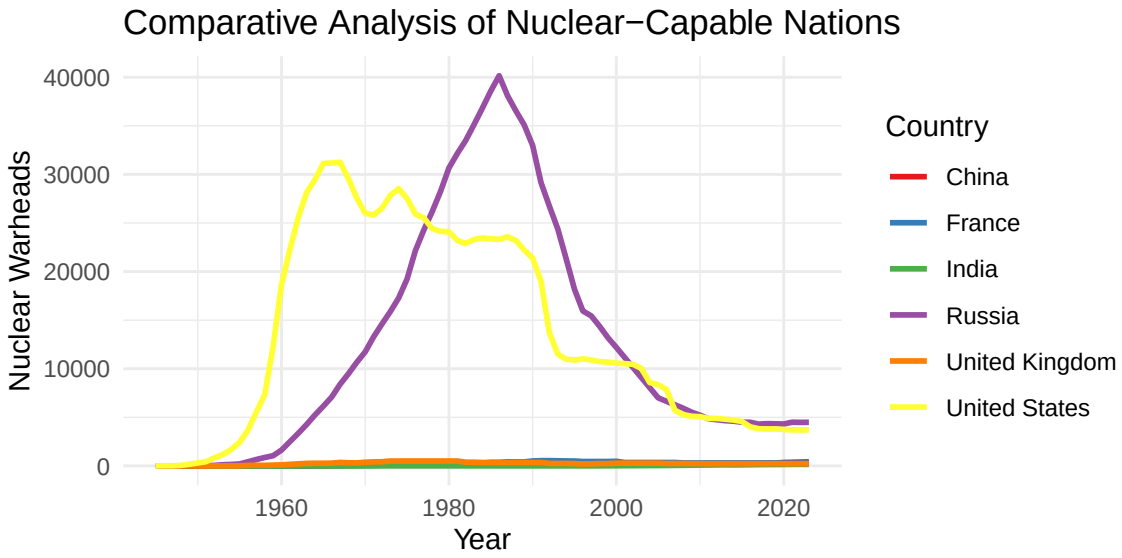
```
global_trend <- nuclear_cleaned %>%
  group_by(Year) %>%
  summarise(Total_Warheads = sum(Warheads, na.rm = TRUE))

ggplot(global_trend, aes(x = Year, y = Total_Warheads)) +
  geom_line(color = "darkred", linewidth = 1) +
  geom_point() +
  theme_minimal() +
  labs(
    title = "Global Trends in Nuclear Warhead Stockpiles",
    x = "Year",
    y = "Total Nuclear Warheads"
  )
```



4. Key Nuclear Powers

The following visualization compares trends in nuclear warhead counts for major countries like the United States, Russia, China, France, India and the United Kingdom.

```
key_countries <- nuclear_cleaned %>%
  filter(Country %in% c("United States", "Russia", "China", "France", "United Kingdom","India"))

ggplot(key_countries, aes(x = Year, y = Warheads, color = Country)) +
  geom_line(linewidth = 1) +
  theme_minimal() +
  labs(
    title = "Comparative Analysis of Nuclear-Capable Nations",
    x = "Year",
    y = "Nuclear Warheads",
    color = "Country"
  ) +
  scale_color_brewer(palette = "Set1")
```



5. Geographical Distribution

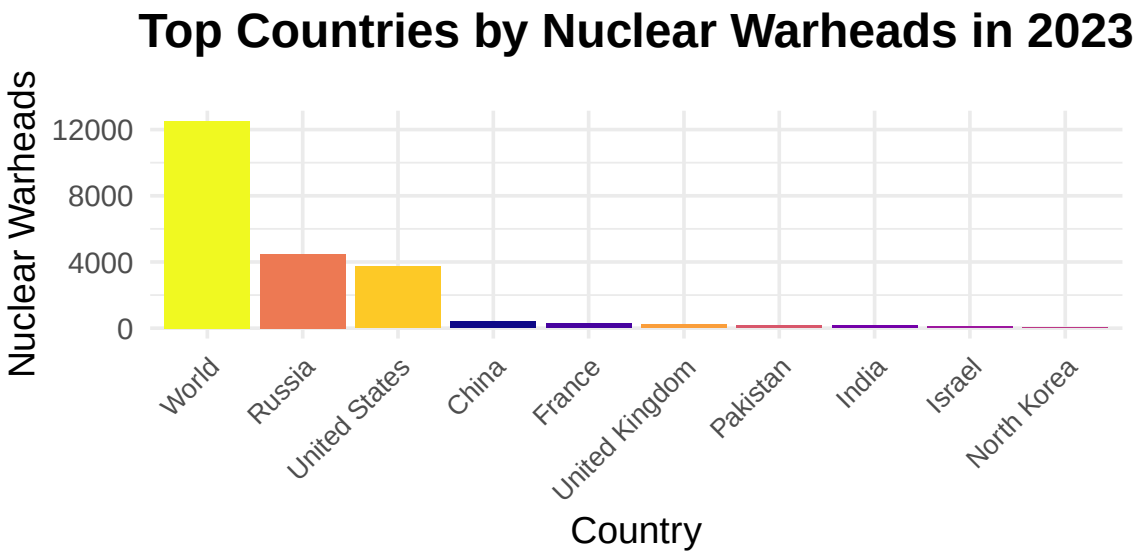
The bar chart below highlights the top countries by nuclear warhead stockpiles in the most recent year.

```
latest_year <- max(nuclear_cleaned$Year, na.rm = TRUE)
latest_data <- nuclear_cleaned %>%
  filter(Year == latest_year) %>%
  arrange(desc(Warheads)) %>%
  top_n(10, Warheads)

unique(latest_data$Country)
```

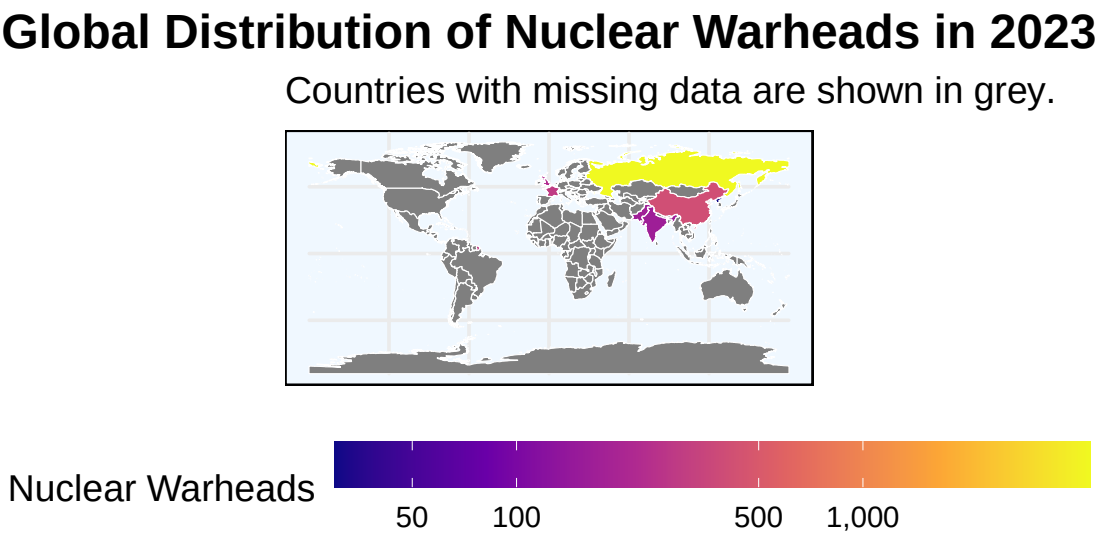
```
##  [1] "World"          "Russia"         "United States"  "China"
```

```
##  [5] "France"         "United Kingdom" "Pakistan"       "India"
##  [9] "Israel"         "North Korea"
```

```
bar_plot <- ggplot(latest_data, aes(x = reorder(Country, -Warheads), y = Warheads, fill = Country)) +
  geom_bar(stat = "identity") +
  theme_minimal(base_size = 14) +
  scale_fill_viridis_d(option = "plasma") +
  labs(
    title = paste("Top Countries by Nuclear Warheads in", latest_year),
    x = "Country",
    y = "Nuclear Warheads"
  ) +
  theme(
    axis.text.x = element_text(angle = 45, hjust = 1, size = 10),
    plot.title = element_text(size = 18, face = "bold", hjust = 0.5, margin = margin(b = 20)),
    legend.position = "none"
  )

# --- World Map ---

world <- ne_countries(scale = "medium", returnclass = "sf")

world_nuclear <- world %>%
  left_join(latest_data, by = c("name" = "Country"))

world_map <- ggplot(data = world_nuclear) +
  geom_sf(aes(fill = Warheads), color = "white", size = 0.1) +

  scale_fill_viridis_c(
    option = "plasma",
    trans = "log",
    breaks = c(50, 100, 500, 1000, 5000, 10000),
    labels = scales::comma,
    name = "Nuclear Warheads"
  ) +

  theme_minimal(base_size = 14) +
  labs(
    title = paste("Global Distribution of Nuclear Warheads in", latest_year),
    subtitle = "Countries with missing data are shown in grey.",
  ) +

  theme(
    panel.background = element_rect(fill = "aliceblue"),
    legend.position = "bottom",
    legend.key.width = unit(2, "cm"),
    plot.title = element_text(size = 18, face = "bold", hjust = 0.5)
  )

# --- Render Plots Separately ---

bar_plot
```




```
world_map
```

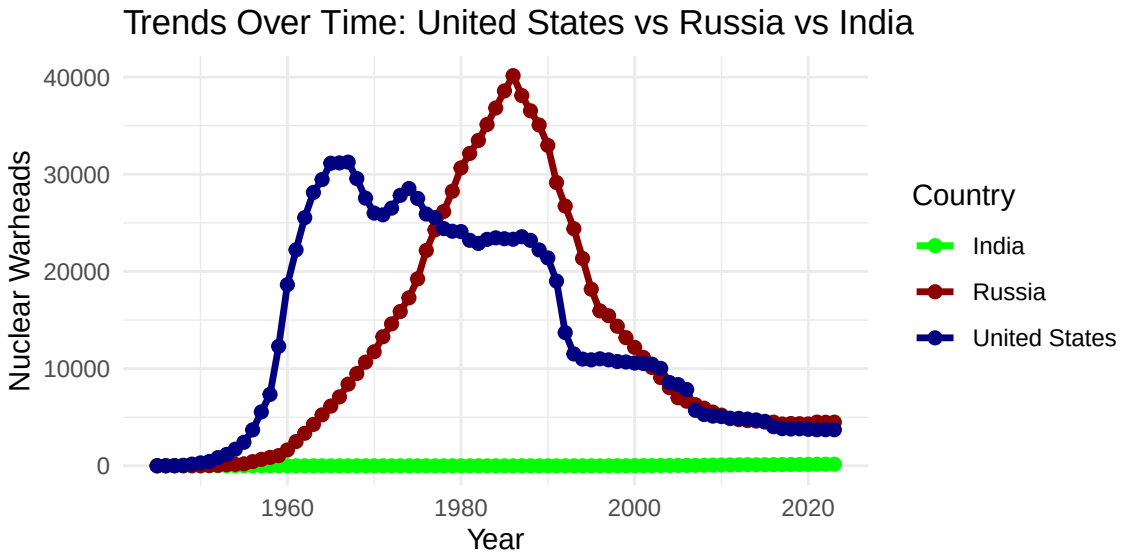


6. Trends Over Time: United States vs Russia vs India

The graph below compares the warhead stockpile trends for the United States, Russia and India.

```
major_countries <- nuclear_cleaned %>%
  filter(Country %in% c("United States", "Russia","India"))

ggplot(major_countries, aes(x = Year, y = Warheads, color = Country)) +
  geom_line(linewidth = 1.2) +
  geom_point(size = 2) +
  theme_minimal() +
```

```
  labs(
    title = "Trends Over Time: United States vs Russia vs India",
    x = "Year",
    y = "Nuclear Warheads",
    color = "Country"
  ) +
  scale_color_manual(values = c("Russia" = "darkred", "United States" = "navy", "India" = "green"))
```



7. Conclusion

Based on the analysis:

Global Reductions: The total global stockpile of nuclear warheads has been declining steadily since the end of the Cold War, indicating successful disarmament efforts.

Dominance of US and Russia: The United States and Russia together account for the majority of global stockpiles, although both nations have significantly reduced their counts since the 1990s.

Emerging Powers: Countries like China have shown gradual increases, which may impact future geopolitical dynamics.

Strategic Defense: Continued monitoring and international treaties are critical to maintaining disarmament momentum.